

AD-A216 067

Final Report
May 1989

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EVT 17-89

TRANSPORTABILITY TEST OF MAVERICK
MISSILE IN CNU-399E/425E
FIBERGLASS CONTAINERS

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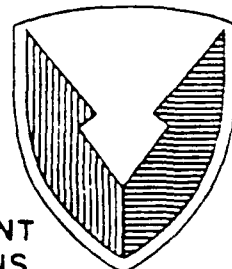
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PREPARED FOR:

Department of The Air Force

Ogden Air Logistics Center

Hill Air Force Base, UT 84056-5999



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SAVANNA, ILLINOIS 61074-9639

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19. ABSTRACT (Continue on reverse if necessary and identify by block number) The U.S. Army Defense Ammunition Center and School (USADACS), Evaluation Division (SMCAC-DEV), was tasked by the Department of the Air Force, Ogden Air Logistics Center (AFLC), Hill Air Force Base, UT, to test outloading procedures for the CNU-399E and CNU-425E Missile Containers. These containers are expected to be shipped on an International Standards Organization (ISO) flatrack by rail, truck and ship. Nine containers were available for testing. Tests were performed with nine containers in a three-high configuration and eight containers in a two-high configuration. With the containers in a three-high configuration, the center of mass is too high for acceptable road transportation. A two-high by two-wide configuration is acceptable for all surface modes of transportation. The completed procedure will have Drawing Number 19-48-7122 for flatrack transportation.					
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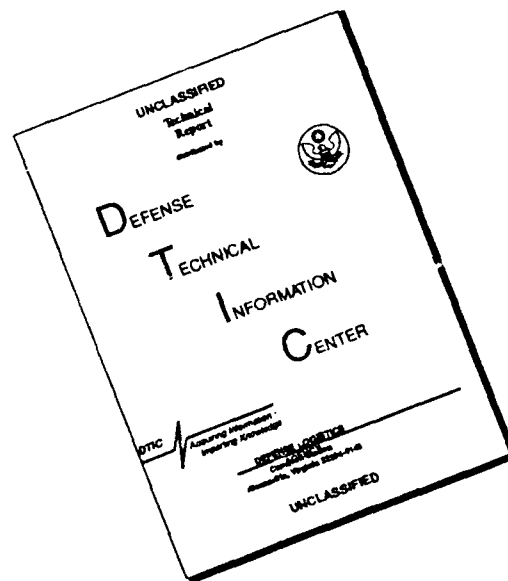
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REPORT NO. EVT 17-89

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Date _____
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PART 1

GENERAL

A. INTRODUCTION

The U.S. Army Defense Ammunition Center and School (USADACS), Evaluation Division (EMCAC-DEV), was tasked by the Department of the Air Force, Headquarters Ogden Air Logistics Center (AFLC), Hill Air Force Base, UT, to test outloading procedures for the CNU-399E and CNU-425E Missile Containers. These containers are expected to be shipped on an ISO Flatrack by rail, truck and ship. The completed procedures will have U.S. Army Materiel Command drawing number 19-48-7122 for Flatrack transportation.

B. AUTHORITY

This test was conducted in accordance with mission responsibilities delegated by the U.S. Army Armament, Munitions and Chemical Command (AMCCOM), Rock Island, IL. Reference is made to Change 4, 4 October 1974, to AR-740-1, 23 April 1971, Storage and Supply Operations; AMCCOM-R 10-17, 13 January 1986, Mission and Major Functions of USADACS.

C. OBJECTIVE

The objective of these tests was to determine if the Maverick Missile in a CNU-399E/425E fiberglass container on an ISO Flatrack would be suitable for a road, ship and rail transportation environment.

D. CONCLUSIONS

Fiberglass Missile Containers, CNU-399E and CNU-425E should not be shipped in a three-high loading configuration. The load center of mass is too high for a stable load. A two-high configuration lowers the center of mass resulting in a more stable load.

The hold-down straps can be over tensioned. This causes the strapping board ends to be driven into the container top causing the fiberglass container top to crack.

E. RECOMMENDATIONS

It is recommended that caution notes be placed in the tiedown procedure drawing to limit hold down strap tension to a point where it will not cause the container top to crack. An additional shock absorbing material should be added between the container and the top strapping boards. Based on these test results, a two-high, two-wide, two-long load configuration is acceptable for all modes of surface transportation.

F. APPROVAL

The loading procedure, 19-48-7122 of CNU-399E/425E Fiberglass Containers, as tested in a two-high, two-wide, two-long load configuration is approved. This approval only applies to the tested configuration. Deviations from the tested configuration are not approved. This approval does not constitute precedence for all modes of shipment until the final approved Storage and Outloading Procedures have been issued.

PART 2

ATTENDEES

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PART 3
TEST PROCEDURES

A. RAIL IMPACT TEST

The test load or vehicle should be positioned in/on a railcar. For containers, the loaded container shall be positioned on a container chassis and securely locked in place using the twist locks at each corner. The container chassis shall be secured to a railcar. Equipment needed to perform the test includes the specimen (hammer) car, five empty railroad cars connected together to serve as the anvil, and a railroad locomotive. These anvil cars are positioned on a level section of track with air and hand brakes set, and with the draft gear compressed. The locomotive unit pulls the specimen car several hundred yards away from the anvil cars and, then, pushes the specimen car toward the anvil at a predetermined speed, disconnects from the specimen car about 50 yards away from the anvil cars and allows the specimen car to roll freely along the track until it strikes the anvil. This constitutes an impact. Impacting is accomplished at speeds of 4, 6, and 8 mph in one direction and at a speed of 8 mph in the opposite direction. The 4 and 6 mph impact speeds are approximate; the 8 mph speed is a minimum. Impact speeds are to be determined by using an electronic counter to measure the time required for the specimen car to traverse an 11-foot distance immediately prior to contact with the anvil cars.

B. HAZARD COURSE

The specimen being tested will be subjected to the road hazard course. Using a suitable truck/tractor or tactical vehicle, the vehicle/specimen of

test method No. 1 shall be towed/driven over a hazard course two times at a speed of approximately 5 mph. The speed may be increased or decreased, as appropriate, to produce the most violent load response.

C. ROAD TRIP

Using a suitable truck/tractor and trailer, or tactical vehicle, the tactical vehicle/specimen load shall be driven/towed for a total distance of at least 30 miles over a combination of roads surfaced with gravel, concrete, and asphalt. Test route shall include curves, corners, railroad crossings, cattle guards, stops, and starts. The test vehicle shall travel at the maximum speed suitable for the particular road being traversed, except as limited by legal restrictions. This step provides for the tactical vehicle/specimen load to be subjected to three full airbrake stops while traveling in the forward direction and one in the reverse direction while traveling down a 7 percent grade. The first three stops are at 5, 10, and 15 mph, while the stop in the reverse direction is of approximately 5 mph.

D. WASHBOARD COURSE

Using a suitable truck/tractor, and/or tactical vehicle, the specimen shall be towed/driven over the washboard course at a speed which produces the most violent response in the particular test load (as indicated by the resonant frequency of the suspension system beneath the load).

E. SHIPBOARD TRANSPORTATION SIMULATOR

The test load (specimen) shall be positioned onto the Shipboard Transportation Simulator (STS) and securely locked in place using the cam lock at each corner. Using the procedure detailed in the operating instruction, the STS shall be started oscillating at an angle of 30 degrees plus or minus 2 degrees, either side of center and a frequency of 2-cycles-per-minute (30

seconds plus 2 seconds total roll period). This frequency shall be maintained for at least 15 minutes during which time the load will be observed for apparent defects that could cause a safety hazard. The frequency of oscillation shall then be increased to 4-cycles-per-minute (15 seconds plus 1 second roll period) and the apparatus operated for two hours. If an inspection of the load does not indicate an impending failure, the frequency of oscillation shall be further increased to 5-cycles-per-minute (12 seconds plus 1 second cycle time), and the apparatus operated for four hours. The operation does not necessarily have to be continuous; however, no change or adjustments to the load or load restraints shall be permitted at any time during the test. The test load (specimen) shall not be removed from the apparatus, after once being set in place, until the test has been completed or is terminated.

PART 4

TEST RESULTS

RAIL IMPACT DATA

TEST NO. 1

DATE: 4 APR 1989

TEST SPECIMEN: TOFC with ISO Flatrack and nine CNU-399E/425E containers.

TEST CAR NO. TTWX 971960 LT. WT. 71,300 pounds

LABING AND DUNNAGE WT. 15,170 pounds

TOTAL SPECIMEN WT. 86,470 pounds

BUFFER CAR (5 CARS) WT. 220,000 pounds

IMPACT NO.	END STRUCK	VELOCITY (MPH)	IMPACT FORCE	REMARKS
1	forward	1.20		no damage
2	forward	4.56		no damage
3	forward	6.04		no damage
4	forward	8.24		no damage
5	reverse	8.18		no damage

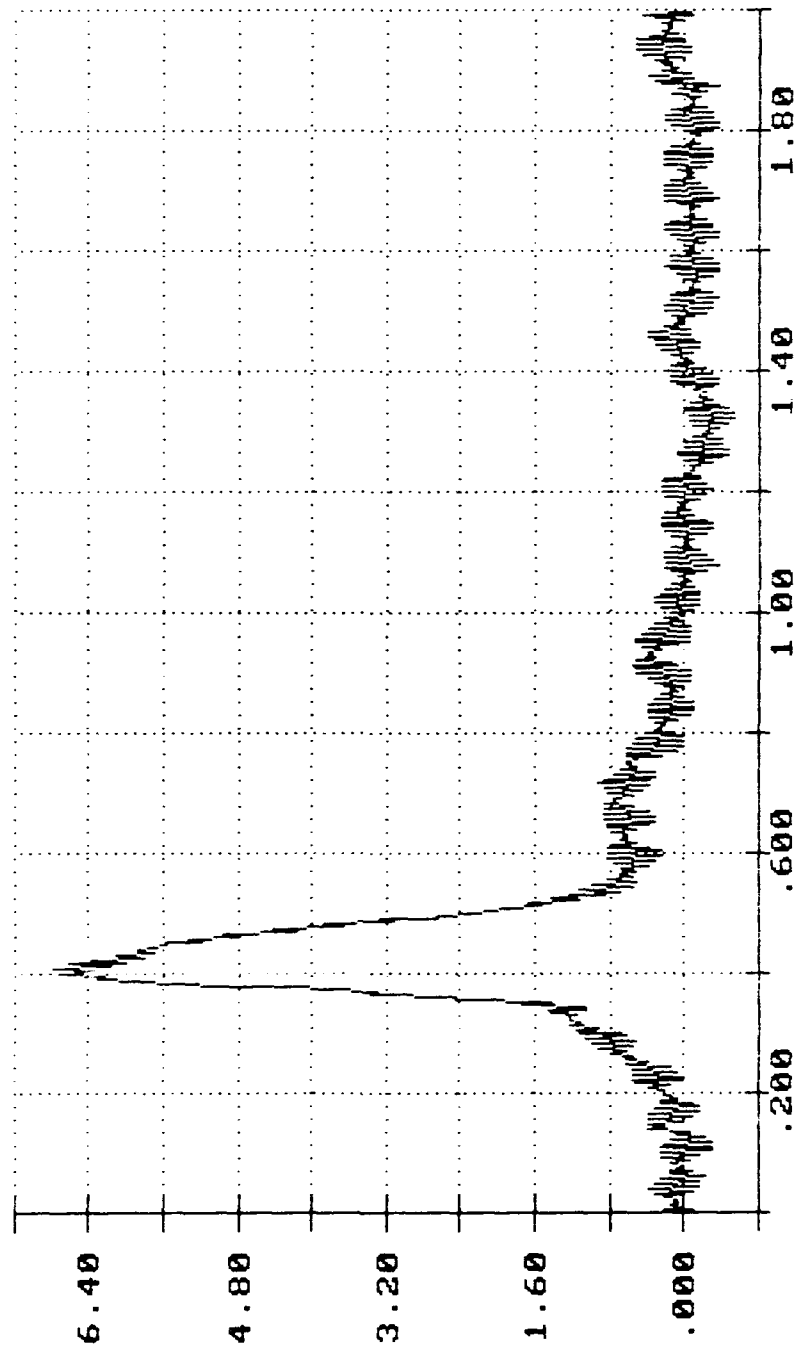
RESULTS FROM THE RAIL IMPACT TEST ON THE
MAVERICK CONTAINERS
DATE: APRIL 4, 1989

TAPE CHANNEL 6: RAIL COUPLER FORCE

TEST	SPEED MPH	PEAK VALUE POUNDS	DURATION MILLISECONDS	AREA POUNDS-SECONDS
-----	-----	-----	-----	-----
IMPACT 1	4.56	67884.14	97.75	5262.77
IMPACT 2	6.04	72754.76	71.43	2762.38
IMPACT 3	8.24	106283.81	212.57	11594.57
IMPACT 4 (REVERSE)	8.18	171988.17	65.99	6929.79

RAIL IMPACT TEST ON THE MAVERICK CONTAINERS

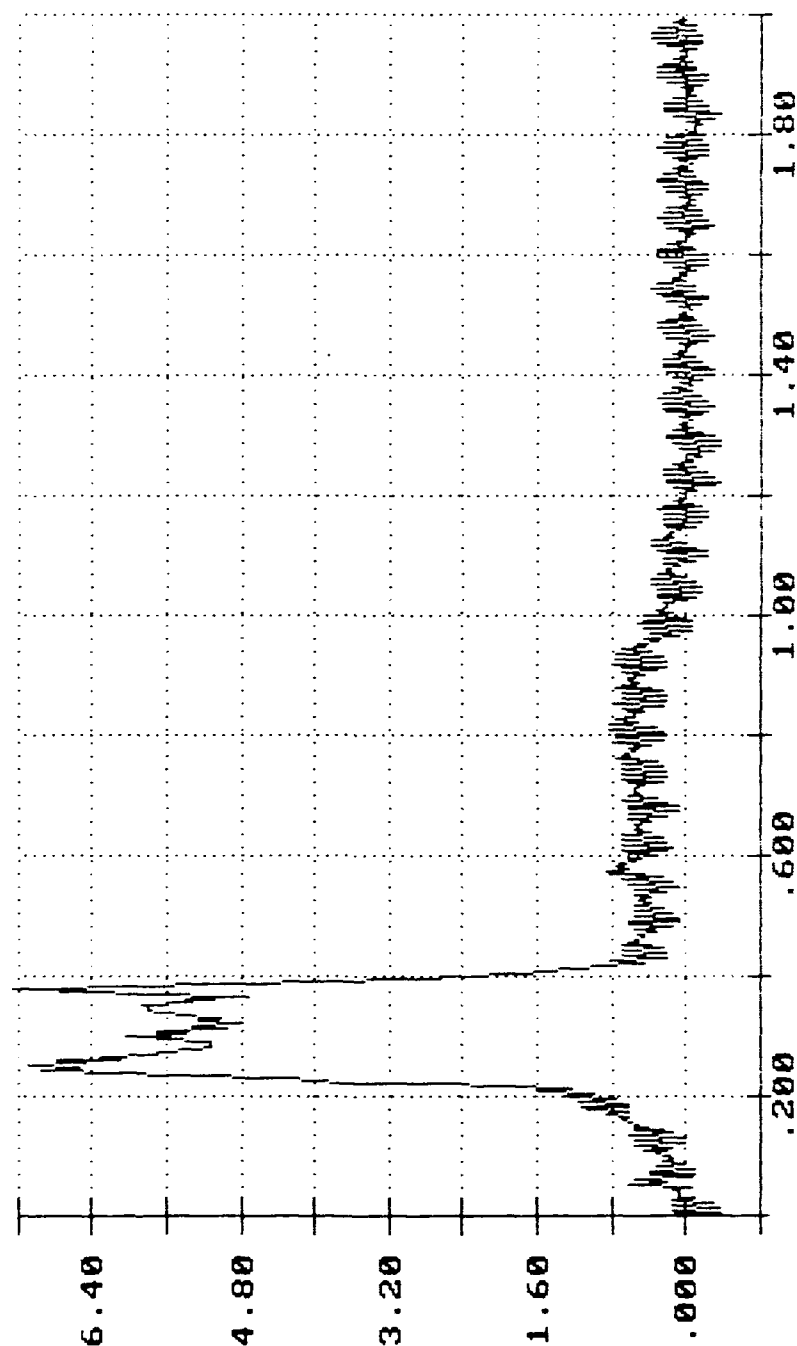
IMPACT 1: 4.56 MPH, DATE: 4 APRIL 1989



Time in Seconds
X 1.00

RAIL COUPLER FORCE
IN POUNDS X 10000.00

RAIL IMPACT TEST ON THE MAVERICK CONTAINERS
IMPACT 2: 6.04 MPH, DATE: 4 APRIL 1989

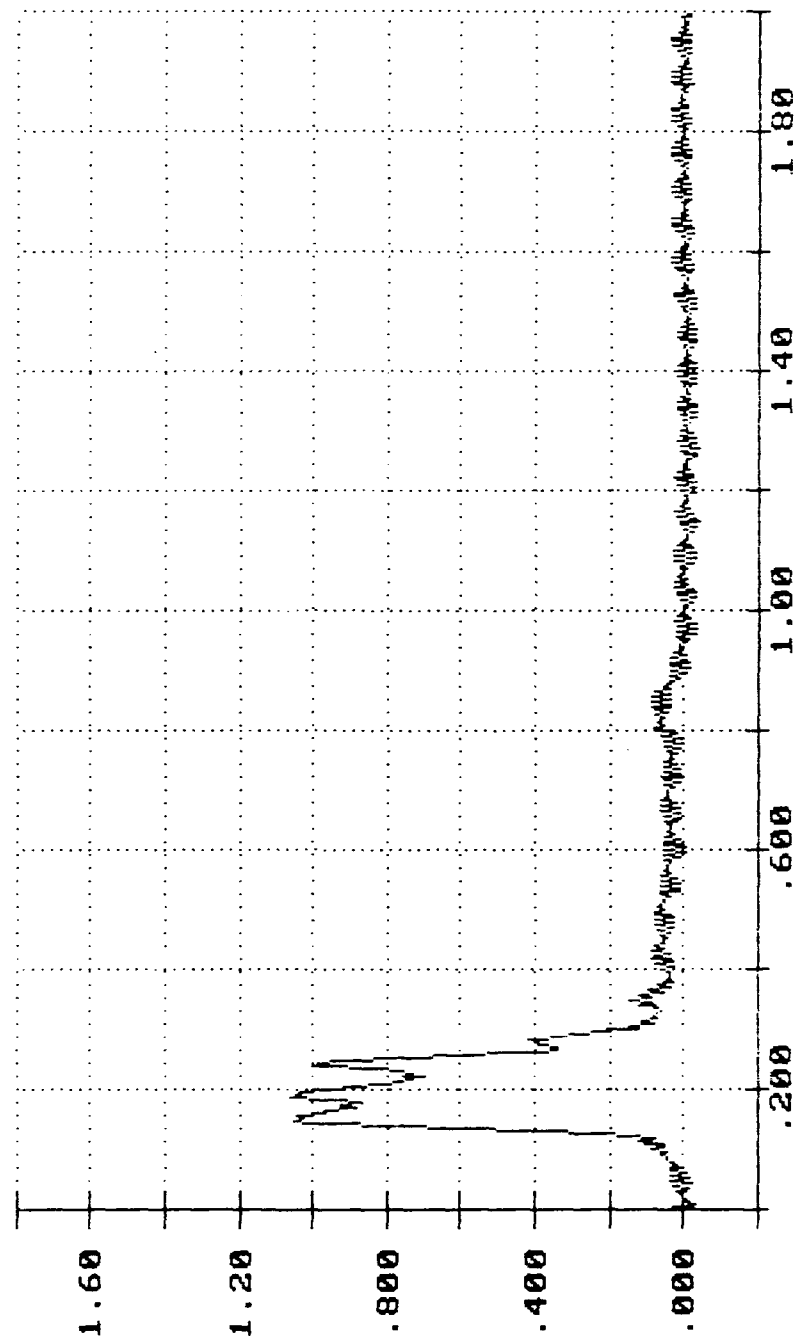


Time in Seconds
X 1.00

RAIL COUPLER FORCE
IN POUNDS X 10000.00

RAIL IMPACT TEST ON THE MAVERICK CONTAINERS

IMPACT 3: 8.24 MPH, DATE: 4 APRIL 1989



Time in Seconds

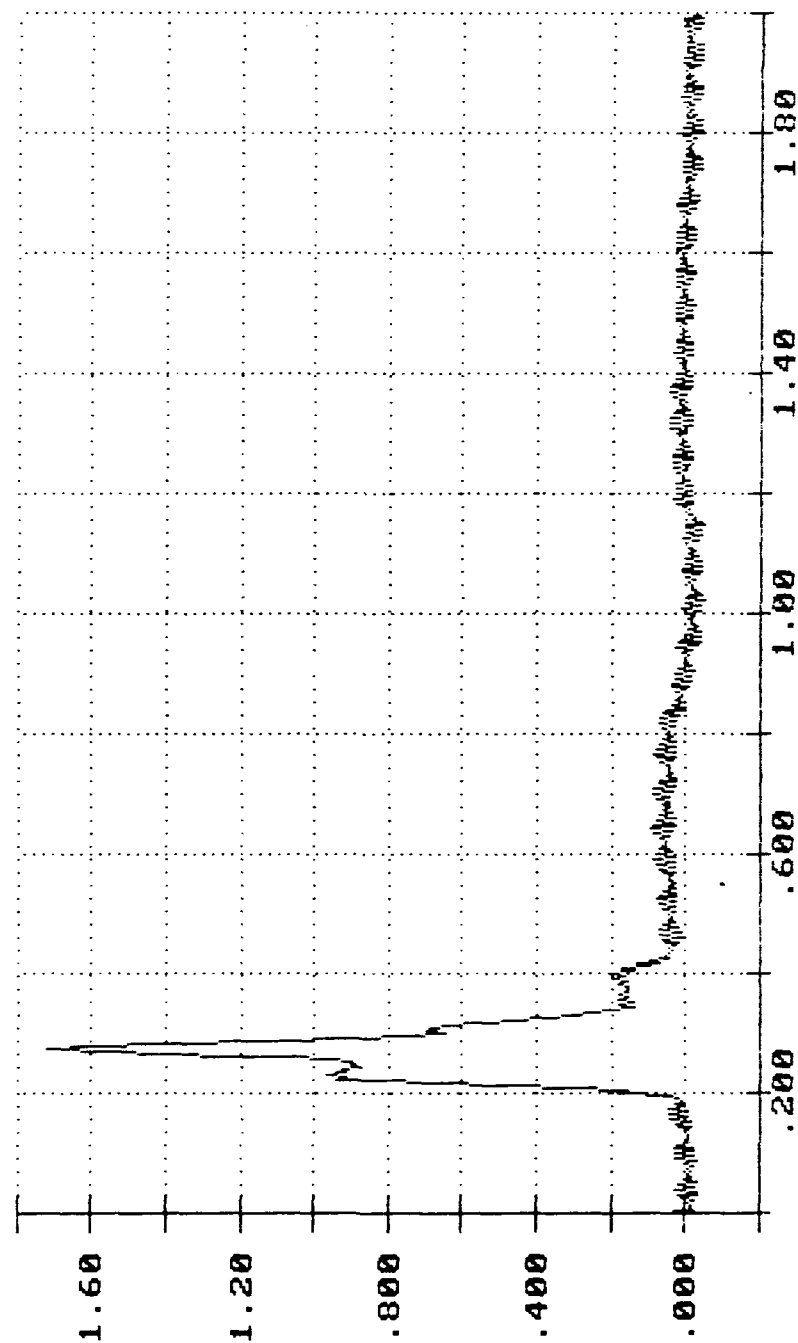
X 1.00

IN POUNDS X 100000.00

RAIL COUPLER FORCE

RAIL IMPACT TEST ON THE MAVERICK CONTAINERS

IMPACT 4: 8.18 MPH, DATE: 4 APRIL 1989



Time in Seconds
X 1.00

IN POUNDS X 100000.00

RAIL COUPLER FORCE

RAIL TEST DATA

TEST NO. 2

DATE: 4 APR 1989

TEST SPECIMEN: CNU-399E/425E Missile Containers on Flatrack. Loading per Test Plan (Method 1).

PASS 1-A OVER FIRST SERIES OF TIES: 0.10 MIN 5.68 MPH

PASS 1-B OVER SECOND SERIES OF TIES: 0.10 MIN 5.68 MPH

REMARKS: Top crossmembers of double wide containers cracked on center line.

PASS 2-A OVER FIRST SERIES OF TIES: 0.095 MIN 6.3 MPH

PASS 2-B OVER SECOND SERIES OF TIES: 0.10 MIN 5.68 MPH

REMARKS: Top container lids cracked and rounded corner joints separated. Test aborted.

CONCLUSION(S): Subject blocking, bracing, tiedown procedures should be redesigned to afford more edge protection to the containers; a wider and thicker strapping board should be used to prevent breakage; and cleats should be added to the strapping board at the outside container edges for better load distribution. An additional shock absorbing material could be added between the container and the top strapping boards. Wider strapping boards could be used for better load distribution between the straps and the container.

RAIL TEST DATA

TEST NO. 3

DATE: 3 MAY 1989

TEST SPECIMEN: CNU-399E/425E Missile Containers on Flatrack. Loading per Test Plan (Method 2).

PASS 1-A OVER FIRST SERIES OF TIES: 0.11 MIN 5.16 MPH

REMARKS: For the rail impact test, nine missile containers were secured to a flatrack in accordance with the developed procedure. The flatrack was placed on a transportation chassis and was subjected to one pass over the hazard course. After the first pass at 5.16 mph (both sections), the strapping boards over the two-wide containers on the flat rack broke through at the 4 x 4 blocked end on one side. One container lid was cracked under the strapping boards opposite the cracked end. One stacking aid on the container was smashed causing the container lid to crack at the mounting holes.

CONCLUSION(S): Subject blocking, bracing, tiedown procedures should be redesigned to clear the stacking aids. An additional shock absorbing material could be added between the container and the top strapping boards. Wider strapping boards could be used for better load distribution between the straps and the container.

ROAD TEST DATA

TEST NO. 4

DATE: 8 MAY 1989

TEST SPECIMEN: CNU-399E/425E Missile Containers on Flatrack. Loading per Test Plan (Method 3).

PASS 1-A OVER FIRST SERIES OF TIES: 0.10 MIN 5.68 mph

REMARKS: For the road hazard test, nine missile containers were secured to a flatrack in accordance with version 3 of the developed procedure. The flatrack was placed on a transportation chassis and was subjected to one pass over the hazard course. After the first pass at 5.68 mph (both sections), the strapping boards over the two-wide containers at the center of the load broke the container lids on each container (outside edge). Both containers were secured side-to-side with a 1-1/4-inch steel strap at the top layer.

CONCLUSION(S): Subject blocking, bracing, tiedown procedures should be redesigned to distribute the stress loading over a larger surface of the containers. An additional shock absorbing material could be added between the container and the top strapping boards. Wider strapping boards could be used for better load distribution between the straps and the container.

ROAD TEST DATA

TEST NO. 5

DATE: 9 MAY 1988

TEST SPECIMEN: CNU-399E/425E Missile Containers on Flatrack. Loading per Test Plan (Method 4).

PASS 1-A OVER FIRST SERIES OF TIES: 0.10 MIN 5.68 mph

PASS 1-B OVER SECOND SERIES OF TIES: 0.10 MIN 5.68 mph

REMARKS: No movement or damage to load

PASS 2-A OVER FIRST SERIES OF TIES: 0.10 MIN 5.68 mph

PASS 2-B OVER SECOND SERIES OF TIES: 0.10 MIN 5.68 mph

REMARKS: No movement or damage to load.

30 MILE ROAD TEST: No damage to load.

PANIC STOP TEST: No damage or load movement.

PASS 3-A OVER FIRST SERIES OF TIES: 0.10 MIN 5.68 mph

PASS 3-B OVER SECOND SERIES OF TIES: 0.11 MIN 5.16 mph

REMARKS: No damage to load.

PASS 4-A OVER FIRST SERIES OF TIES: 0.10 MIN 5.68 mph

PASS 4-B OVER SECOND SERIES OF TIES: 0.095 MIN 6.00 mph

REMARKS: No damage to load.

WASHBOARD COURSE: No damage to load.

SHIPBOARD TRANSPORTATION SIMULATOR: No damage to load or flatrack.

RAIL IMPACT DATA

TEST NO. 6

DATE: 23 May 1989

TEST SPECIMEN: TOFC with ISO Flatrack and eight CNU-399E/425E containers

TEST CAR NO. TTX 153621

LT. WT. 74,800 pounds

LADING AND DUNNAGE

WT. 14,083 pounds

TOTAL SPECIMEN

WT. 88,884 pounds

BUFFER CAR (5 CARS)

WT. 221,000 pounds

IMPACT NO.	END STRUCK	VELOCITY (MPH)	REMARKS
1	forward	4.36	No load movement or damage.
2	forward	6.14	No load movement or damage.
3	forward	8.32	No load movement or damage.
4	reverse	8.03	No load movement or damage.

RESULTS FROM THE RAIL IMPACT TEST ON THE
MAVERICK CONTAINERS
DATE: MAY 23, 1989

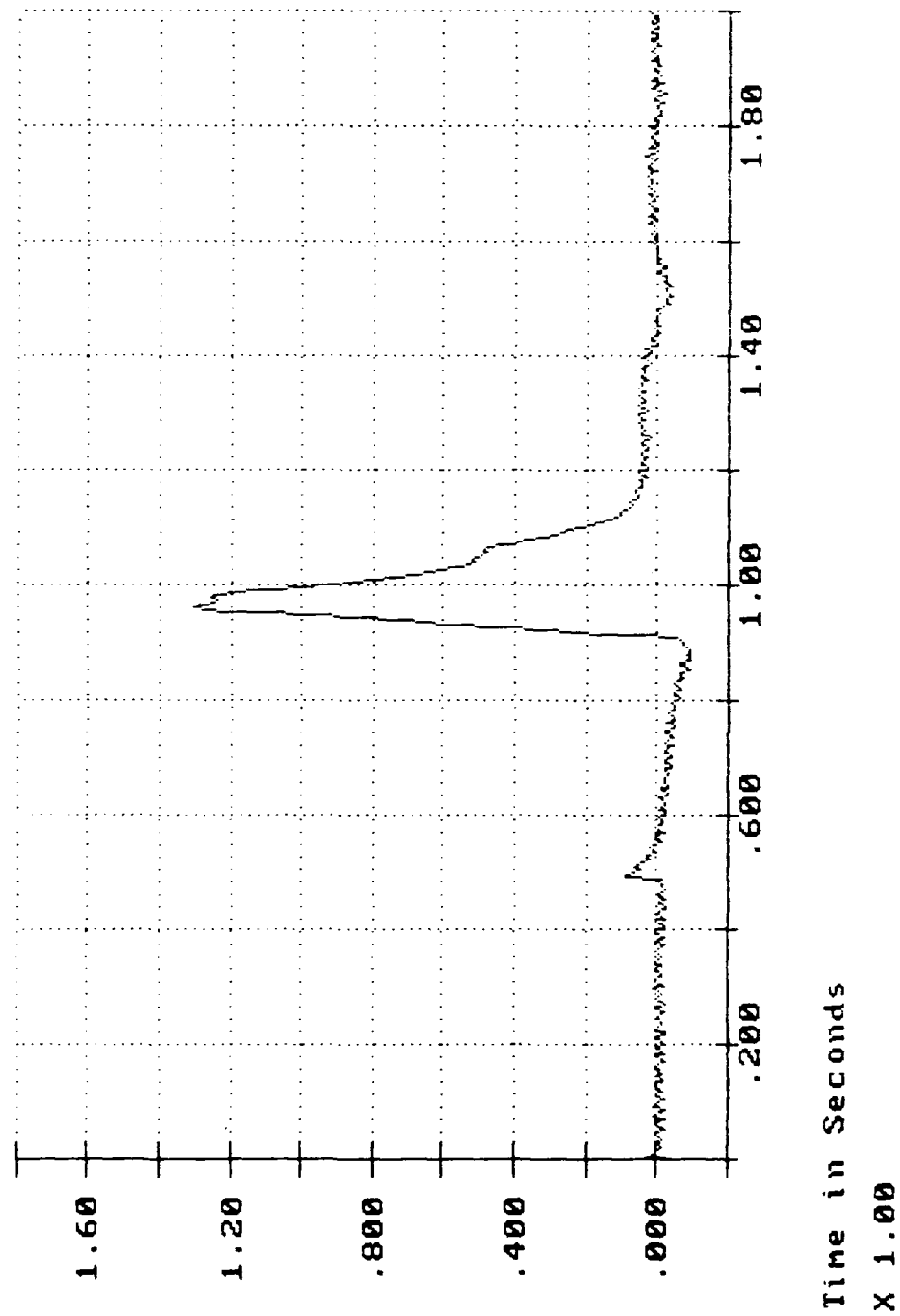
TAPE CHANNEL 1: RAIL COUPLER FORCE

TEST	SPEED MPH	PEAK VALUE POUNDS	DURATION MILLISECONDS	AREA POUNDS-SECONDS
-----	-----	-----	-----	-----
IMPACT 1	4.36	130320.84	208.72	13375.97
IMPACT 2	6.14	119364.99	137.70	12126.44
IMPACT 3	8.32	223161.44	69.08	11071.28
IMPACT 4	8.03	209960.94	73.05	11006.59

RAIL COUPLER FORCE

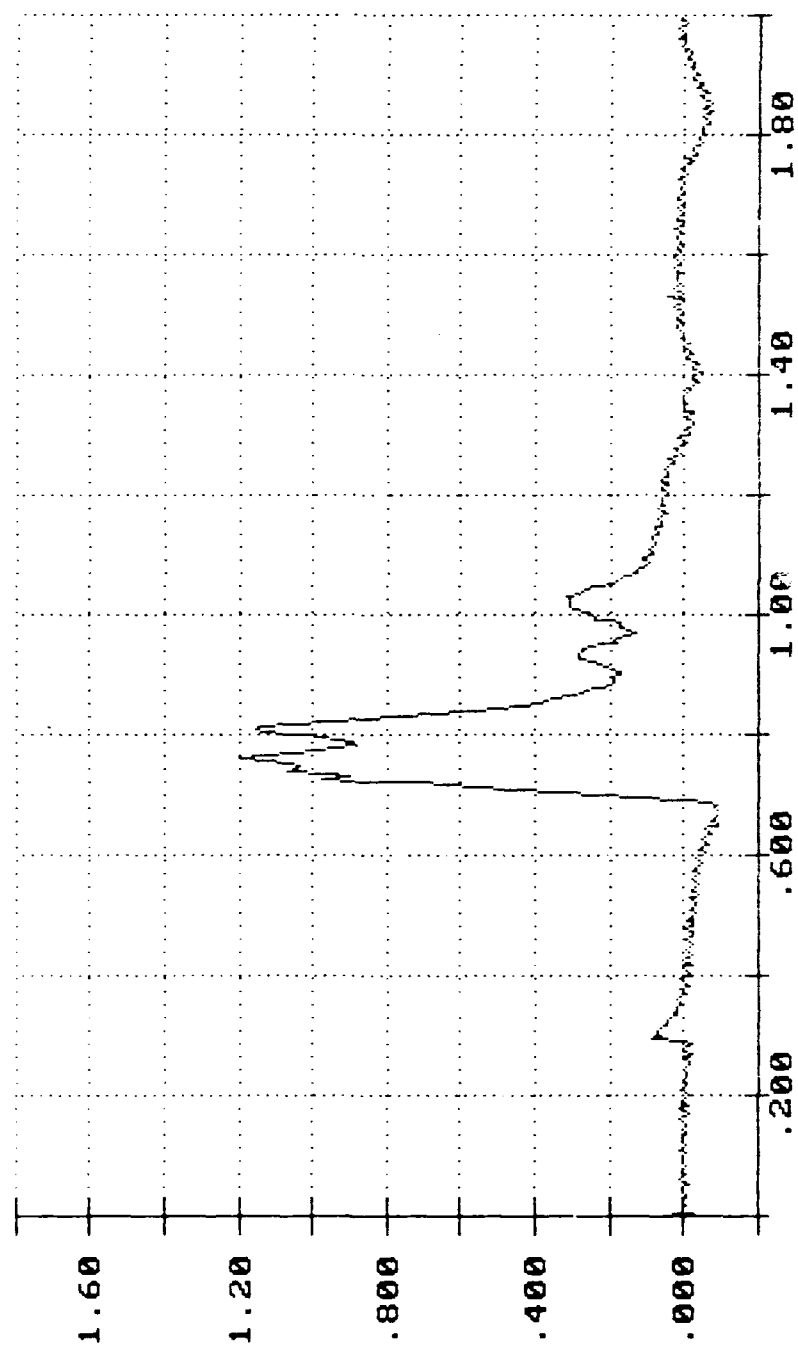
IN LBS X 100000.00

RAIL IMPACT OF MAVERICK MISSILE CONTAINERS
IMPACT 1: 4.36 MPH, DATE: 05-23-89



RAIL IMPACT TEST OF MAVERICK MISSILE CONTAINERS

IMPACT 2: 6.14 MPH, DATE: 05-23-89



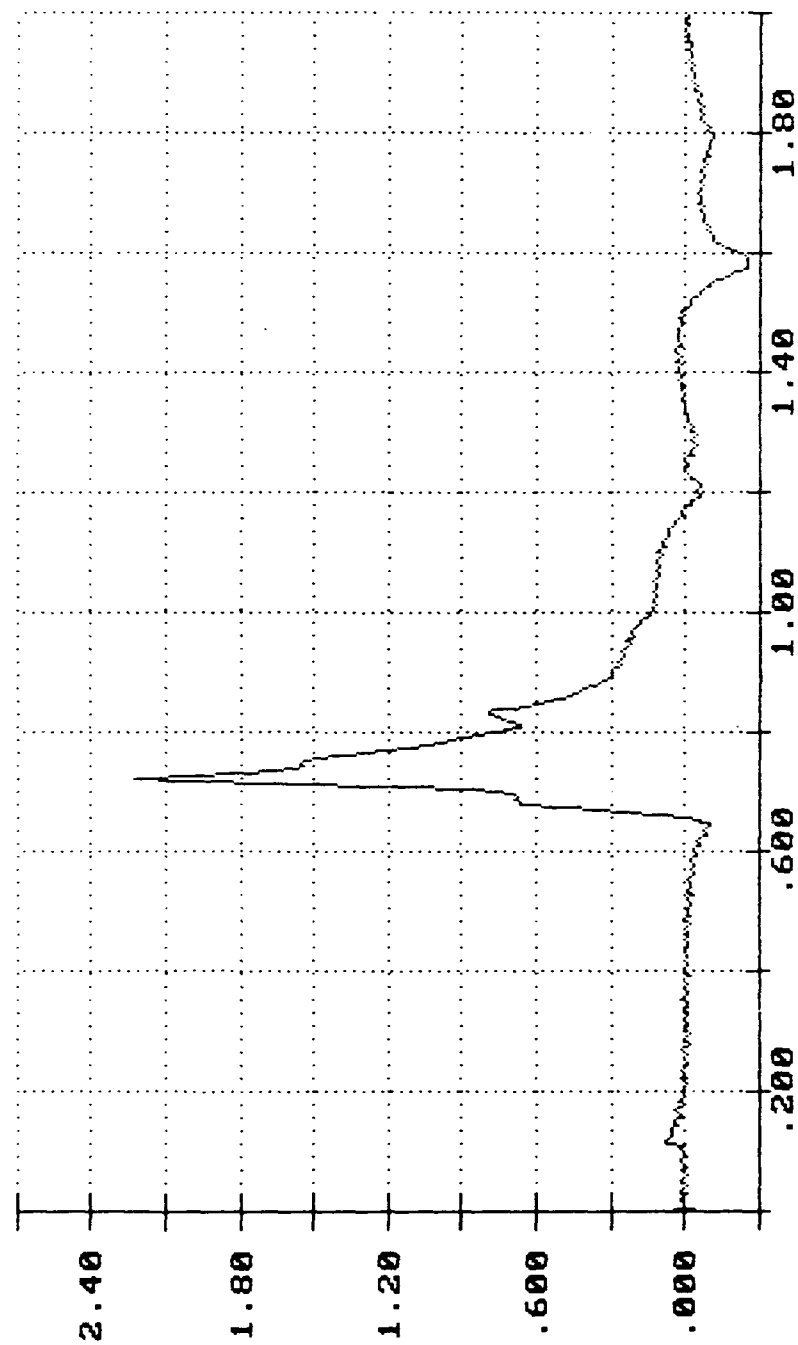
Time in Seconds
X 1.00

IN LBS X 100000.00

RAIL COUPLER FORCE

RAIL IMPACT TEST OF MAVERICK MISSILE CONTAINER

IMPACT 3: 8.32 MPH, DATE: 05-23-89



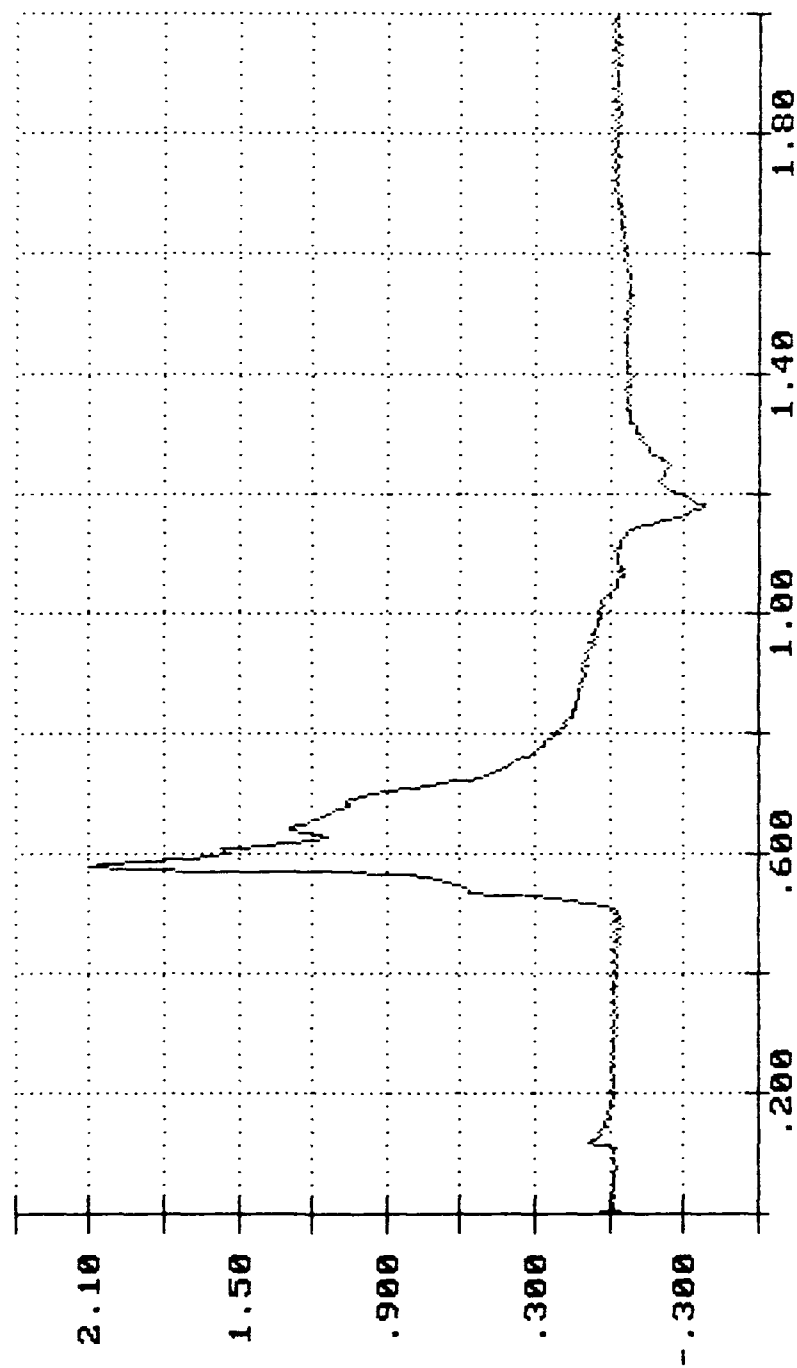
Time in Seconds
X 1.00

IN LBS X 100000.00

RAIL COUPLER FORCE

RAIL IMPACT TEST OF MAVERICK MISSILE CONTAINERS

IMPACT 4: 8.03 MPH, DATE: 05-23-89



Time in Seconds
X 1.00

IN LBS X 100000.00

RAIL COUPLER FORCE

PART 5

TEST PLANS

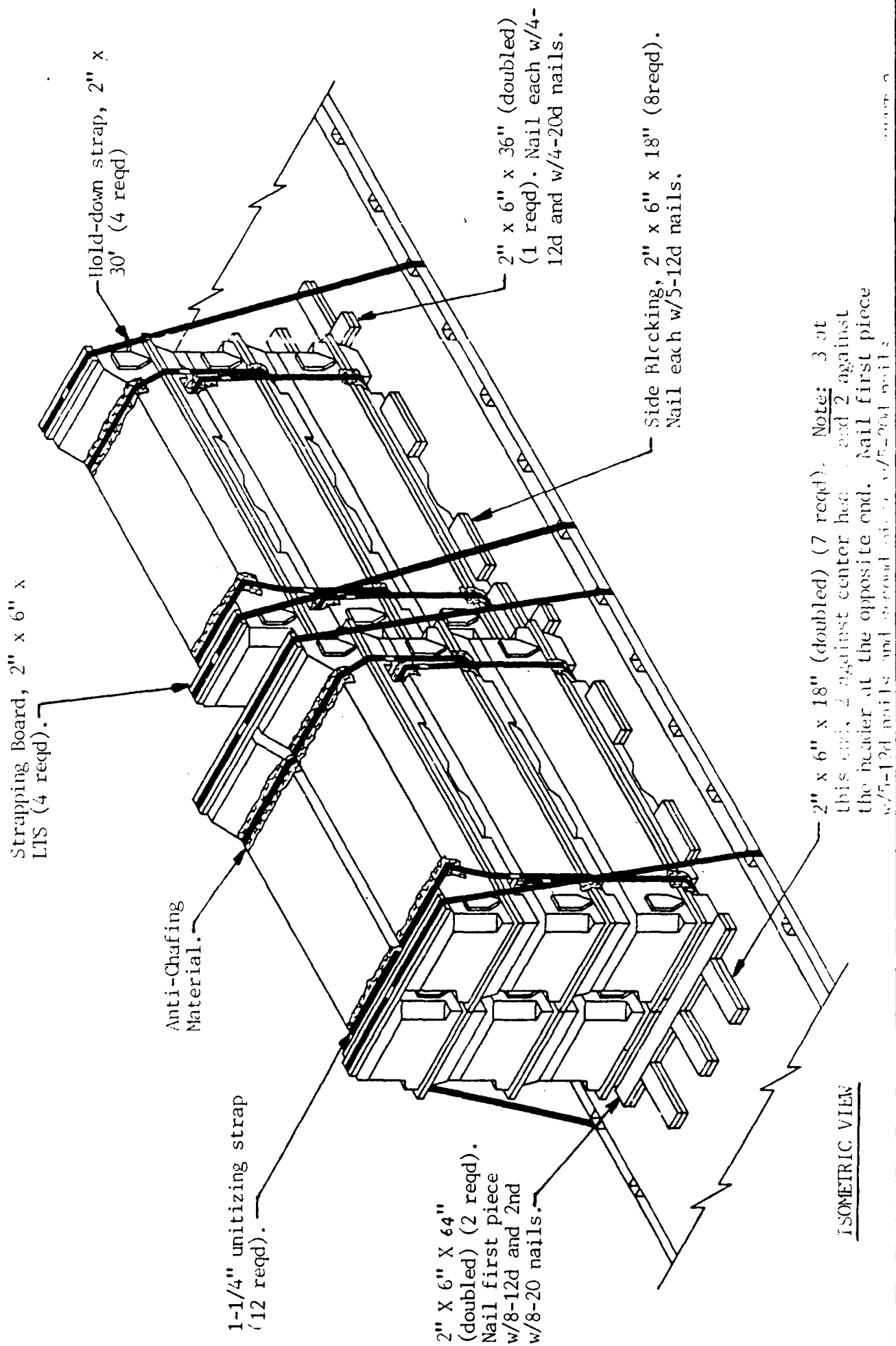
TEST PLAN

MAVERICK MISSILE IN CNU-425E CONTAINER

This 3-page sketch delineates a load of AGM-65 (MAVERICK) missiles on a flatbed trailer.

The load as shown is based on a shipment of nine (9) containers, however, up to eighteen (18) containers may be transported on a 40'-0" long flatbed trailer by using similar procedures as depicted herein.

Prepared during March 1989 by:
U.S. Army Defense Ammunition
Center and School
Savanna, IL 61074-9639



BILL OF MATERIAL			
Lumber	LF	BF	
2" x 6"	88	44	
Nails	No. Req'd.	Pounds	
12d	135	2-1/4	
20d	55	2	
1-1/4" Strap	198' Req'd	28	Lbs
2" Strap	120' Req'd	40	Lbs
1-1/4" Seals	12 Req'd	1/2	Lb
2" Seals	12 Req'd	2	Lbs
Anti-Chafing	As Req'd	NIL	

LOAD AS SHOWN

<u>ITEM</u>	<u>DUNNAGE</u>	<u>WEIGHT (APPROX)</u>
CNU-425E	9	9,135 Lbs
Dunnage		163 Lbs
Total Weight		9,298 Lbs

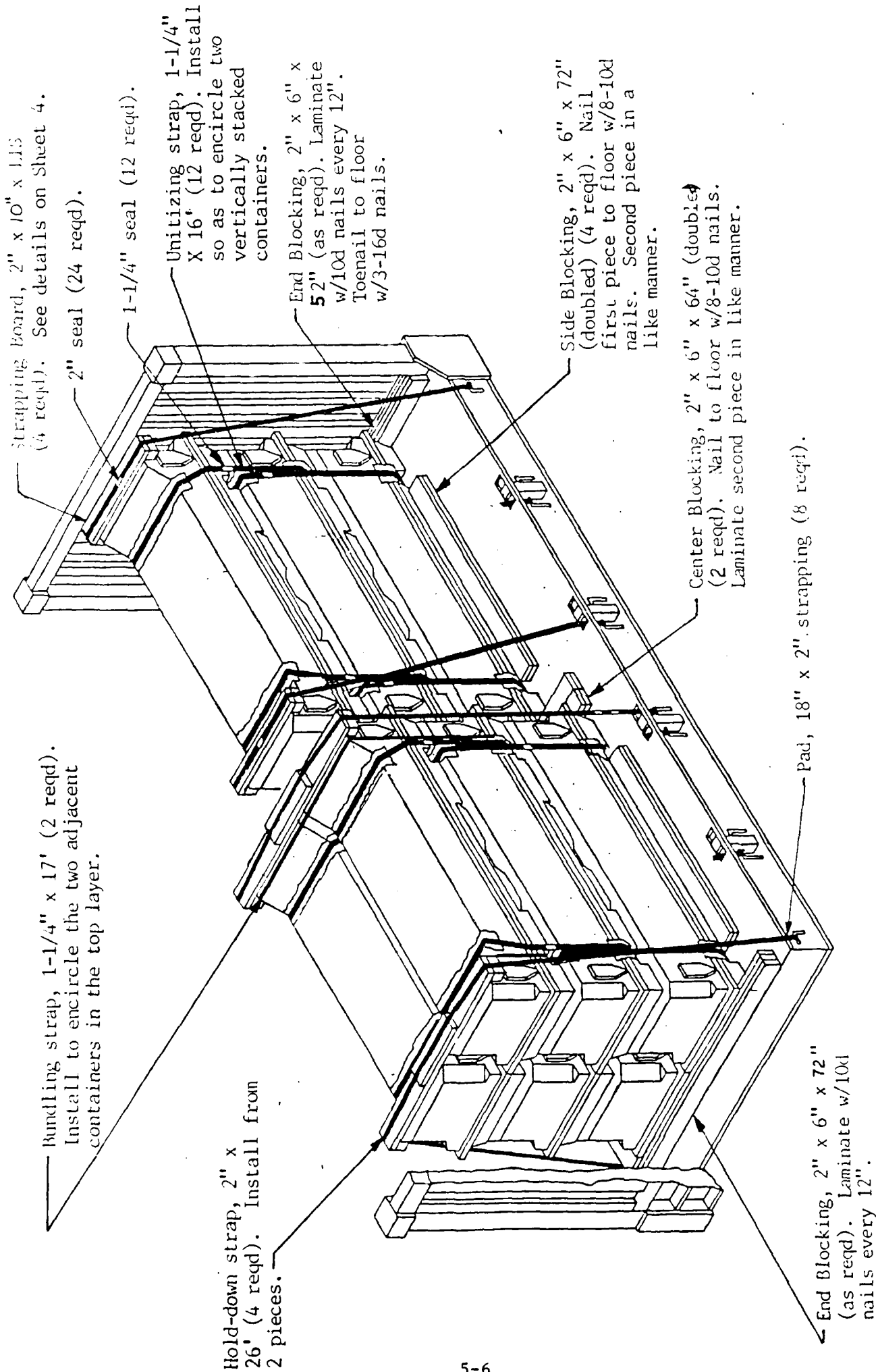
TEST PLAN (METHOD 2)
MAVERICK MISSILE IN CNU-425E CONTAINER

This 4-page sketch delineates a load of AGM-65 (MAVERICK) Missiles on an ISO flatrack container.

The load as shown is based on a shipment of nine (9) containers, however, up to twelve (12) containers may be transported on a flatrack container by using similar procedures as depicted herein.

Prepared during April 1989 by:

U.S. Army Defense Ammunition Center
& School
ATTN: SMCAG-DEO
Savanna, IL 61074-9639



ISOMETRIC VIEW

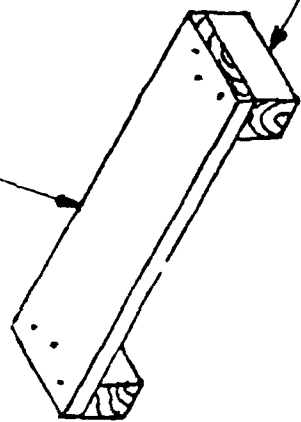
SHEET 2

BILL OF MATERIAL		
LUMBER	LF	BF
1" X 6"	5	3
2" X 6"	100	100
2" X 10"	19	32
4" X 4"	6	8
NAILS	NO. REQD	POUNDS
6d	4	NIL
10d	148	2
16d	3	NIL
1-1/4" Strap-----	226' Reqd-----	32 Lbs
2" Strap-----	116' Reqd-----	39 Lbs
1-1/4" Seals-----	14 Reqd-----	1/2 Lb
2" Seals-----	24 Reqd-----	5 Lbs
Anti-Chafing-----	As Reqd-----	NIL

LOAD AS SHOWN

ITEM	QUANTITY	WEIGHT (Approx)
CNU-425E-----	9-----	9,135 Lbs
Dunnage-----		365 Lbs
Flatrack-----		5,732 Lbs
Total Weight-----		15,232 Lbs

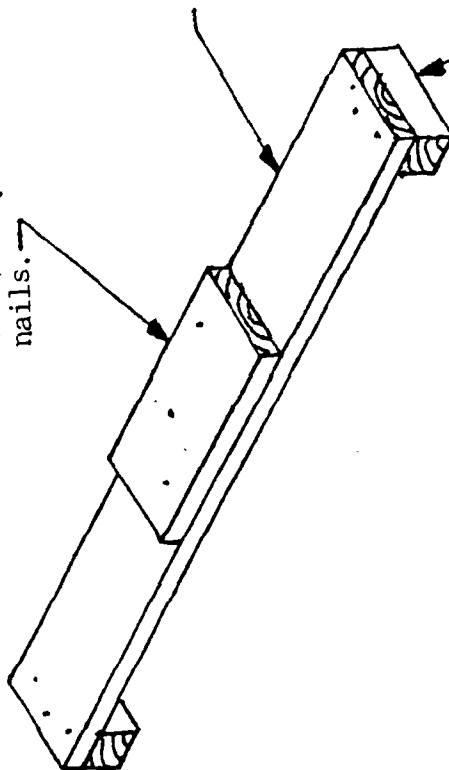
2" x 10" x LTS (1 reqd). Nail to the blocks w/3-10d nails.



4" x 4" x Length to suit (2 reqd).

STRAPPING BOARD A

Purchase board, 2" x 10" x 18" (1 reqd). Nail w/3-10d nails.



2" x 10" x LTS (1 reqd). Nail to the blocks w/3-10d nails.

4" x 4" x Length to suit (2 reqd).

STRAPPING BOARD B

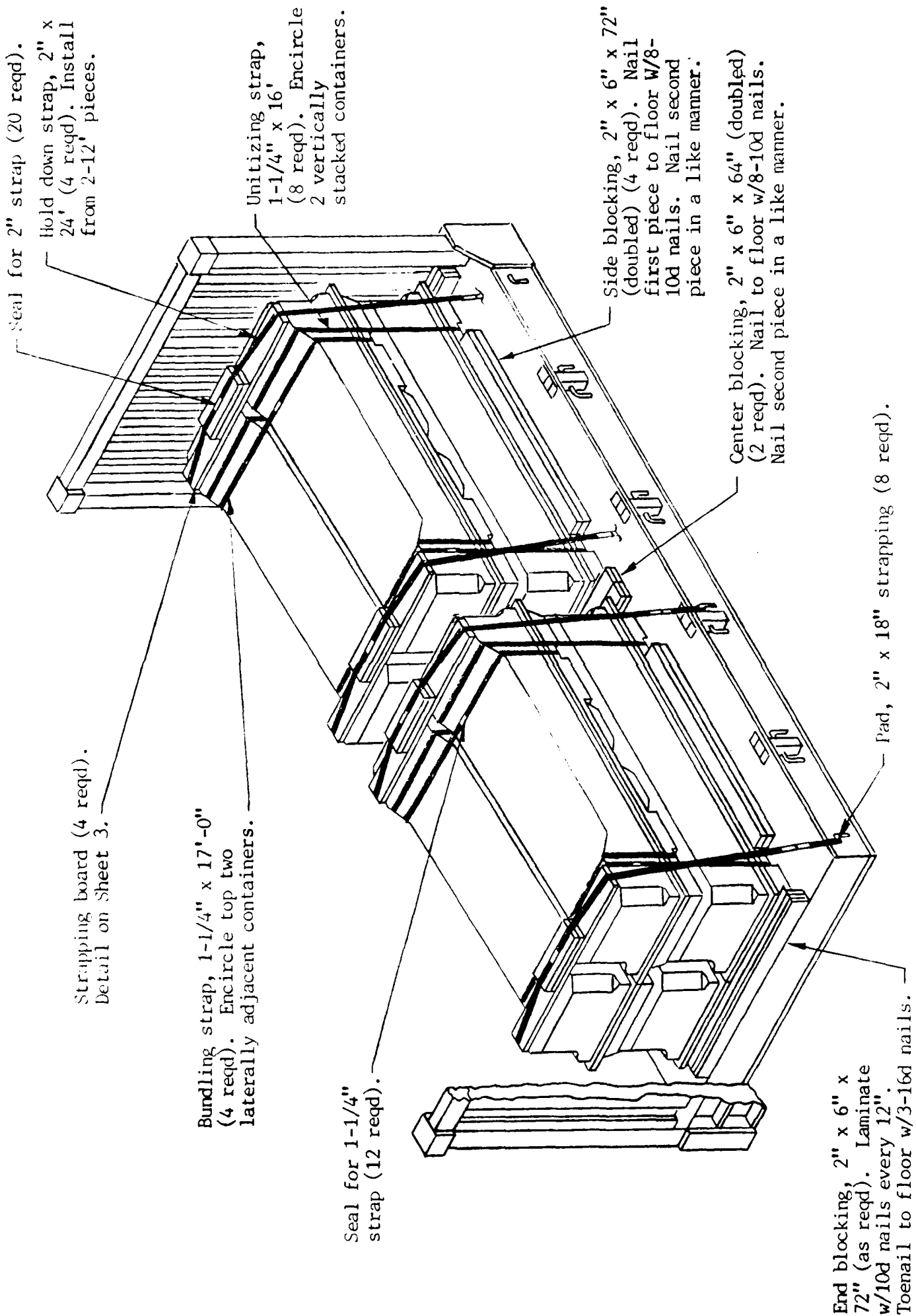
TEST PLAN (METHOD 3)

MAVERICK MISSILE IN CNU-425E CONTAINER

This 3-page sketch delineates a load of AGM-65 (MAVERICK) Missiles on an ISO flatrack container.

The load as shown is based on a shipment of eight (8) containers.

Prepared during May 1989 by:
U.S. Army Defense Ammunition
Center & School
ATTN: SMCAC-DEO
Savanna, IL 61074-9639

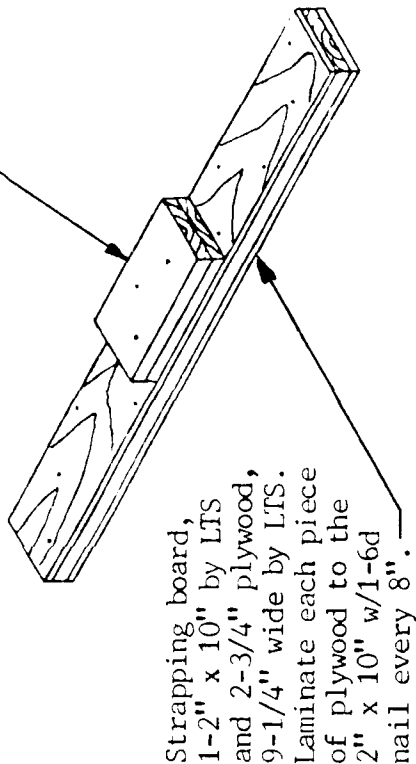


ISOMETRIC VIEW

BILL OF MATERIAL			
LUMBER	LINEAR FEET	BOARD FEET	
1" x 6"	6	3	
2" x 6"	105	105	
2" x 10"	36	60	
NAILS	NO. REQD	POUNDS	
6d	64	1/2	
10d	150	2	
16d	6	NIL	
3/4" Plywood-----36 Sq Ft-----70 Lbs			
1-1/4" Strap-----200' Req-----28 Lbs			
2" Strap-----108' Req-----36 Lbs			
1-1/4" Seals-----12 Req-----1/2 Lb			
2" Seals-----20 Req-----4 Lbs			
Anti-Chafing-----As Req-----NIL			

5-11

Purchase board, 2" x 10" x 18" (doubled) (1 reqd).
 nail each piece w/3-10d nails.



STRAPPING BOARD ASSEMBLY A

LOAD AS SHOWN

ITEM	QUANTITY	WEIGHT (APPROX)
CNU-425E-----	8	8,120 Lbs
Dunnage-----		477 Lbs
Flatrack-----		5,732 Lbs
Total Weight-----		14,329 Lbs